

*From the Dict*

A N

EXPERIMENTAL INQUIRY

INTO THE NATURE AND QUALITIES OF THE

CHELTENHAM WATER.

BY

A. FOTHERGILL, M. D. F. R. S.

PRICE ONE SHILLING AND SIX-PENCE.

EXPERIMENTAL INQUIRY

INTO THE NATURE AND CAUSES OF THE

CHELSEA WATER

BY

A. ROBERTSON, M.D. F.R.S.

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A N E W

EXPERIMENTAL INQUIRY

INTO THE NATURE AND QUALITIES OF THE

CHELTENHAM WATER;

WITH A CONCISE ACCOUNT OF THE

D I S E A S E S

WHEREIN IT IS CHIEFLY INDICATED;

AND THE

DIET AND REGIMEN,

NECESSARY TO ITS SUCCESSFUL USE.

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BY A. FOTHERGILL, M.D. F.R.S.

MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS IN LONDON,

OF THE

MEDICAL SOCIETIES OF LONDON AND EDINBURGH;

AND PHYSICIAN IN BATH.

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*Intrandum est in rerum naturam, et penitus quid  
Ea postulat pervidendum*—————

CICERO.

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B A T H :

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T O T H E

REV. JAMES STONHOUSE, M. D

RECTOR OF GREAT AND LITTLE CHEVEREL, WILTS;

AND MANY YEARS PHYSICIAN

TO THE NORTHAMPTON INFIRMARY:

WHOSE SKILL AND HUMANITY AS A PHYSICIAN,

WHOSE ZEAL AND ELOQUENCE AS A PREACHER,

AND WHOSE EXEMPLARY CONDUCT AS A DIVINE,

HAVE CONSPIRED TO RENDER HIM

AN ORNAMENT TO BOTH PROFESSIONS:

AND, WHAT IS MORE IMPORTANT,

T H E

FRIEND AND BENEFACTOR OF MANKIND:

THE FOLLOWING INQUIRY,

AS A SINCERE, THOUGH INCONSIDERABLE

TRIBUTE OF GRATITUDE AND ESTEEM,

IS RESPECTFULLY INSCRIBED,

BY HIS MOST OBLIGED FRIEND,

AND VERY HUMBLE SERVANT,

THE AUTHOR.

BATH,

June 13th, 1785.

QUÆ PRESENTI OPUSCULO DESUNT SUPPLEAT ÆTAS.

QUINTIL.

ERRATA.—Page 15, line 10, for *Specific* read *Comparative* passim; p. 44  
l. 2, for *constituents* r. *constituent*; p. 51, l. 4, omit *materially*; p. 54  
l. 13, for *these* r. *those*; p. 58, l. 6, for *delicacy* r. *importance*; p. 61  
l. 1, for *saeson*, r. *season*.

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## INTRODUCTION.

**H**AVING occasion last summer to drink the Cheltenham Water, I made an excursion to the SPA; accompanied by two Gentlemen; to whom I had lately recommended a course of the water.

On our arrival, curiosity prompted me to dip into the writings of Dr. SHORT, and OTHER AUTHORS who have treated on Mineral Waters; but instead of meeting with the desired information concerning the present  
b subject,

subject, I soon found myself involved in a labyrinth of perplexities.

While some of them extol the Cheltenham Water as being unrivaled, others degrade it to a mere solution of purging salt. While some pronounce it to be a very *brine of nitre*, others contend for the presence of *real sulphur*. Among such discordant opinions, what judgment can be formed of it by the public? What information conveyed to remote Practitioners? Or how are the Faculty to decide, who never had, and probably never may have, an opportunity of examining it on the spot?

Such however is the present state of knowledge concerning this, and indeed of many other Mineral Waters in the kingdom! Consequently Invalids, who resort to them, must

either

either content themselves with drinking the waters at random to the great risque of their health, or ground their hopes of success on the most vague, and contradictory assertions! Can we wonder then, that many, who begin them improperly, should soon feel themselves disappointed, and at length quit them with disgust?

The Authors who have favoured the world with their Analyses of Mineral Waters, have indeed collected their solid contents, with considerable exactness, and from thence have they generally deduced their real, or imaginary virtues. But it is to be regretted, they have so seldom attended to the volatile aërial parts which escaped during the process, though these confessedly constitute the most active ingredients in the composition.

Much however is still due to their labour and industry, and even their errors may claim our indulgence, as their success probably kept pace with the lights that were afforded them. It seems to have been reserved for the present age, to developé the mystery concerning the Mineral Spirit of Waters hitherto considered as *inscrutable*; and also to demonstrate that many of the substances which have appeared to be simple, are in reality compounds. Thus pure water itself, though uniformly esteemed a simple element, is now known to consist of a certain proportion of *dephlogisticated* and *inflammable* air, as has been lately proved both synthetically and analytically.\* In like manner, the earthy and Chalybeate principle of Mineral Waters, though confi-

\* See Mr. CAVENDISH's Experiments, Phil. Trans. vol. lxxiv. art. 13. Also M. LAVOISIER's Obser. sur la Physique, tom. xxiii. p. 452.

dered as simple bodies, generally contain, nevertheless, a portion of *fixed air*, which, by uniting with them, forms new compounds possessed of their own peculiar properties. In a word, the late brilliant discoveries concerning *aërial fluids*, have already produced so considerable a revolution in former systems, as to constitute a new, and important æra in chemistry. As those lead to a more accurate knowledge of the constituent parts of natural bodies, so they cannot but materially influence the doctrine of Mineral Waters.

The increasing reputation of the Cheltenham Water having attracted the attention of the Public, intitles it to a closer investigation than appears yet to have been bestowed on it. I resolved therefore to embrace so favourable an opportunity of satisfying myself more  
thoroughly

thoroughly concerning its Mineral Contents, which have been so differently represented. But being wholly unprovided with the apparatus necessary to the undertaking, I was obliged to content myself with such materials as the place afforded. These were supplied in the most obliging manner, by Mr. CLARKE, an ingenious Surgeon in Cheltenham, who, together with the Gentlemen who accompanied me from Bath, kindly lent every assistance in their power.

The following Experiments being intended chiefly as the amusement of a few leisure hours, were nevertheless carefully conducted, and the phænomena minuted down as they occurred, though without descending to unnecessary minuteness. A paper, containing the result, was afterwards communicated to  
my

my WORTHY COLLEAGUES of the BATH PHILOSOPHICAL SOCIETY, and OTHER COMPETENT JUDGES. Had it not been honoured with their approbation, and since patronized by a LEARNED FRIEND, it would scarcely have ventured to meet the PUBLIC EYE.

Having no interest to serve either in depreciating the water, or exaggerating its virtues, no particular theory to support, nor any object in view except that of truth, I have sometimes been obliged to controvert certain doctrines which have long been implicitly received as sacred oracles, by many persons who frequent the Spa. In attempting, however, to point out the errors of others, I shall ever be ready candidly to acknowledge my own, and to rectify any oversight that may have escaped me in the following pages.

Conscious

Conscious of the difficulty of the undertaking, and the fallacy to which experiments of this nature are liable, the present Analysis is by no means offered as *complete*. If it tends but to advance the chemical history of the water a few steps nearer the truth, or contributes in any degree towards a more rational, and successful use of it; the Author's principal aim will be accomplished, and his time fully compensated.



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*Situation and Present State of*

CHELTENHAM SPA.

CHELTENHAM is a market-town in Gloucestershire, near a mile long, situated in a sandy vale, partly environed by high rocks and hills. The air is esteemed very pure, and the adjacent country extremely fertile. About a quarter of a mile south of the church, adjoining to a spacious gravel walk adorned with beautiful elms, rises the CHELTENHAM SPA.

The spring issues very slowly from a sandy soil intermixed with loam and clay; and though it has been calculated to yield only about 35 pints in an hour, it will be found

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fully

fully sufficient to supply upwards of 350 persons. The well is sunk about 6 feet deep, and shut down with doors that exclude the free communication with the external air, and the water is raised by a common pump. The sides of the well are tinged with a yellow ochre, where a saline efflorescence has also sometimes been observed to germinate. It is recorded, that the medicinal virtues of this spring first began to be noticed about the year 1715, since which it has been more or less frequented. The company have increased of late years, and the Spa is now become a place of very genteel resort during the summer months, insomuch that a Master of the Ceremonies has lately been appointed to preside over its amusements.\* Already Cheltenham exhibits a handsome Pump-room, two Ball-rooms, and a Theatre. For which the company are principally indebted to the zeal of the public-spirited proprietor of the Spa,

\* SIMEON MOREAU, esq.

WM. MILLER, esq; who has spared neither pains, nor expence, in his laudable exertions for the accommodation of a numerous, and polite company. The emulation which he hath kindled, will, it is hoped, excite the inhabitants to improve the public roads, and also to render the Inns, and Lodging-houses, more commodious.

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*Sensible Qualities of the Water—Specific Gravity—Temperature.*

The water, on being poured into a glass, appears tolerably clear, though not of a chrystal transparency. After standing a few minutes, air-bubbles are seen to collect on the sides of the glass, and at length the water becomes less pellucid. It has a smart, brackish, irony taste; and emits a slight fetid odour, of the hepatic kind. This last becomes more perceptible on certain changes

of the atmosphere, and particularly against rain. When shook briskly in a close phial, if the cork be suddenly drawn, it discharges more air-bubbles than common water treated in the same way.

Its specific gravity, when fresh drawn, has been computed at 50 grains in a pint greater than distilled water; which by exposure to the open air, has sometimes increased to near 70 grains. But I have lately found on examining it accurately, after it had stood several months in bottles tight corked and sealed down, that its increased gravity only amounted to 66 grains. This difference in the result, probably depended on difference of temperature derived from the external air.

Its temperature on fundry trials, and at different times of the day, I perceived to vary between 53 and 55° of Fahrenheit's thermometer, being a few degrees warmer than  
 some

some of the neighbouring pumps and springs with which it was compared.\*

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*Experiments exhibiting its appearances with  
Precipitants.*

Exp. 1. *With tincture of galls*, it instantly strikes a vivid purple, which by standing grows darker, inclining to a dusky green, with a variegated pellicle on the surface. If a glass of the water be exposed to the open air, it entirely loses this tinging property in half an hour, and with it its smartness on the palate.

\* The temperature of a well lately sunk in the adjacent grounds of Lord Falconberg, which seems to partake of a similar saline impregnation, but devoid of the Chalybeate principle, was only 51°, though shut up in like manner from the outward air; whereas a new Chalybeate spring at the opposite extremity of Cheltenham, near the mill, which was opened for my inspection, proved to be nearly of the same temperature as that of the Spa, though exposed to the air. This water strikes purple with galls, and deposits a rich ochrey sediment: but my time would not admit of further experiments.

2. *Vitrolic Acid* produced a slight ebullition, accompanied with a discharge of air-bubbles, and afterwards rendered the water more transparent. The same was afterwards observed with the nitrous acid.

3. *Lixivium Tartari* occasioned a milkiness, followed by a copious precipitation of a white sediment.

4. *Solution of Silver in Nitrous Acid* instantly produced white clouds, followed by a dark pearl-coloured precipitation of a grumous appearance.

5. *Solution of Mercury in Nitrous Acid* gave thick clouds, and a precipitation inclining to yellow.

6. *Solution of Sugar of Lead* occasioned white clouds, followed by a precipitation of a whitish sediment.

7. *Solution*

7. *Solution of corrosive Sublimate* produced a whitish cloud, and after standing some time, a slight precipitation ensued.

8. *New milk* mixed uniformly with the water without affording any mark of coagulation, nor did it visibly coagulate as some have asserted, even when boiled with an equal quantity of the water.

9. *Lime Water* rendered it turbid, and a precipitation of the lime ensued.

10. *Soap* dissolved in the water was immediately decomposed, and the solution put on a curdly appearance.

11. *Syrup of Violets* produced a green colour.

12. *Common Water distilled*, being used as a standard, underwent no sensible change on  
the

the addition of the foregoing precipitants, except a very slight cloudiness from the solution of silver.

13. A pint of the Cheltenham water, fresh drawn into a Florence flask, yielded spontaneously about two ounce measures of air into a limber bladder previously cleared of its air, and firmly tied to the mouth of the flask. And after being placed sometime in a vessel of boiling water, it gave out a further quantity, so that the whole appeared to amount to three ounce measures. The air thus collected was conveyed into a large phial of lime water, the mouth of which was inverted in quicksilver, and the whole agitated gently from time to time. Upon which the lime water became turbid, and a slight precipitation ensued. About two-thirds of the air being imbibed by the water, and having precipitated the lime, was evidently fixed air. The residue, which appeared to be  
common



common air, was doubtless in a *phlogisticated* state, for reasons that will be hereafter assigned. The water in the flask had now totally lost its tinging property with galls, and was become vapid to the taste on being thus deprived of its aërial principles.

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*Contents collected by Evaporation.*

14. A gallon of the water, being gently evaporated to dryness, during the process, threw up to the surface a whitish pellicle which afterwards subsided, and when the water was consumed, there was left a brown mass tinged with ochre. The salts obtained from it by repeated elutriation with distilled water, and subsequent evaporation, weighed 485 grains. The residuum left in the filter when dried, weighed 70 grains. The whole, making allowance for the water essential to the crystals, amounted to 555 grains.

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The salt shot into irregular hexagonal prisms, the two opposite sides broader, truncated at one end, and at the other terminating in an oblique pyramidal apex; cold, and bitter to the palate, and in appearance exactly similar to the *Sal Mirabile* of Glauber. Besides which, a few cubic crystals amounting to 5 grains, which proved to be sea-salt, together with a portion of saline matter, which towards the close of the evaporation assumed a soft powdery form not admitting of crystallization, which appeared to be unneutralized magnesia. This experiment was again repeated with the same quantity of the water, and nearly with the same result. The salts were preserved, and afterwards subjected to the following experiments.

15. On dissolving some of the larger crystals in distilled water, and adding a few drops of a solution of fixed alkali, a white cloud appeared, and remained suspended about the middle of the glass.

16. On lime water being dropt into a solution of this salt in another glass, it became cloudy, and of a pearl colour, and a slight precipitation ensued, whereas a solution of common Glauber's salt underwent no precipitation from either fixed alkali or lime water, but remained transparent as before.

17. On adding a few drops of tincture of litmus\* or syrup of violets, to a solution of Cheltenham salt in distilled water, no sensible change ensued.

18. Paper dipt in a saturated solution of this salt, and then dried, did not deflagrate when applied to the flame of a candle, as it

\* Litmus is a blue pigment formed from Archal, a species of moss brought from the Canary and Cape de Verd Islands. The tincture is obtained by steeping this pigment inclosed in clean linen cloth in distilled water. A single drop of concentrated vitriolic acid has been found to communicate a visible red tinge to at least 408 cubic inches. Hence its utility as an exquisite test for discovering the minutest portion of acidity in waters, insomuch that fixed air itself, one of the weakest acids, is incapable of escaping it without being immediately detected.

is known to do when dipt in a solution of nitre, nor did it burn with a green flame, as it is wont to do from a solution of calcarious nitre.

19. The Cheltenham salt was found to be soluble in less than its own weight of water in the temperature of  $60^{\circ}$ , whereas the common Glauber salt required near three times its weight to dissolve it in the same temperature. Although this salt contains near half its weight of water in its chrystaline state, it did not prove deliquescent like calcarious nitre, but remained permanent in a moist air, and in a dry air calcined spontaneously. Thrown on ignited iron it liquefied, rising into blisters, but without affording any detonation like nitre as some have pretended,\* neither did it coagulate milk when boiled with it, as others have asserted.†

The

\* See Dr. Short on Mineral Waters.

† Editor of the 4th Edition of Ruffel on Sea Water, 1760. Also RUTTY on Mineral Waters;—p. 133.

20. The earthy residuum mentioned in Exp. 14, which remained insoluble in water, weighed 70 grains. It effervesced with acids, and turned syrup of violets green. The vitriolic acid converted part of it into a selenitic substance or gypsum, similar to that which forms an incrustation on the inner surface of the kettle, in which the water is occasionally heated at the Spa.

21. The residue when dried, did not discover any magnetic property, till it had undergone a slight calcination with charcoal, when some minute particles were attracted by the magnet.

22. A gentleman who frequents the Spa, having preserved two bottles of the water 22 years, as a matter of curiosity requested me to examine it. The water on being poured into a glass was clear, and perfectly free from any bad odour. It turned syrup of violets  
green,

green, but tasted flat; and had entirely lost its tinging property with galls, agreeably to what I expected.

23. Having ordered two bottles of the water fresh drawn to be well corked and sealed down at the pump before my departure, I examined it by fundry experiments six weeks after my return to Bath, and found it still retained some degree of smartness on the palate, and changed tincture of litmus to a faint red, but had quite lost the tinging property with galls.

24. Leaving the bottle uncorked till the water became vapid, it was then poured into the glass apparatus invented by Dr. Nooth for impregnating water with fixed air, and exposed to the effluvia of an effervescent mixture of chalk and vitriolic acid, till it was fully saturated. It now tinged the litmus of a vivid red, sparkled on being poured  
into

into the glass, and tasted brisker than at the fountain head. On immersing a small piece of iron in the remainder, and leaving it in the vessel all night, the water next morning had completely recovered the Chalybeate quality, struck a deep purple with galls, and finally threw up a variegated film to the surface (on exposure to the air) which reflected the prismatic colours.

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*Inferences from the preceding Experiments.*

I shall now proceed to illustrate the foregoing experiments, and to deduce from them a few inferences by way of induction.

*Exp. 1.* The fundry precipitants employed in analyzing waters, it must be observed, can only serve to point out the *quality* not the *quantity* of their respective mineral ingredients. From this experiment it appears, that  
the

the water contains iron, since no other metal strikes this colour with *galls*. A single drop of the tincture is sufficient to give a distinct purple tinge to 100 cubic inches of distilled water, containing only three grains of martial vitriol, yet three grains of the vitriol contain no more than  $\frac{1}{4}$ th of a grain of iron. Where the quantity of iron is considerable, instead of a purple, it gives a black tinge. When it exists in the form of martial vitriol, the colour is more permanent; when it is suspended by fixed air, it is more evanescent, as in the present instance. The reason why this water so soon loses its tinging quality will be afterwards more fully considered.

2. From this experiment with *vitriolic acid*, we learn, that the water contains an earthy substance suspended by means of fixed air. The vitriolic acid by superior attraction seizes the earth, and forces the air to quit its hold; hence the more copious discharge of  
air-



air-bubbles, and increased transparency. It further appears, that the earth is of the calcareous or absorbent kind; for had it been the *terra ponderosa*, which is sometimes suspended by fixed air, it would have been precipitated by the vitriolic acid in form of spar.

3. Here the fixed alkali, by the same law of attraction, shews the presence of earth, or a neutral salt with an earthy basis.

4. The Solution of Silver, in this experiment, points out a minute portion of sea-salt, which it enables us to detect in a very large quantity of water.

5. The Solution of Mercury discovers another neutral salt, of which the vitriolic acid forms one of the ingredients, but is not sufficient to determine whether it be Glauber's Salt, or Epsom.

6; 7, Confirm the presence of an earthy substance, and particularly of Magnesia.

8. In this experiment, the ready union of the water with milk, without producing any decomposition, shews the error of those practitioners who prohibit a milk diet, during a course of this water, from its supposed coagulating quality. And the result of *experiment* 19, may be sufficient to correct the same popular prejudice, which also attributes a coagulating property to the salt.

9. The precipitation of the lime in this experiment, affords a satisfactory test of the presence of fixed air. The air, having a more powerful attraction for the quick lime than for the water, quits the latter to unite with the former; and thereby renders the lime insoluble in a watery menstruum.

10. The decomposition of soap argues the presence of calcareous earth, or magnesia,  
which

which here detached the oil of the soap from the alkali with which it was combined. Fixed air indeed is capable of producing a similar effect, though in a less sensible degree.

11. The green colour imparted to Syrup of Violets, tends to confirm the conclusions drawn from some of the preceding experiments, particularly as to calcareous earth or magnesia.

12. This experiment with distilled water affords a striking contrast between the effects of precipitants on the Cheltenham water, and simple water free from any mineral impregnation. For the appearance observed with Solution of Silver, can only be attributed to some slight accidental impurity.

13. This experiment presents us with an aerial fluid, a considerable portion of which being loosely attached to the water, exhaled

spontaneously into the bladder placed to receive it, while the residue being more closely united to the terrene parts, required the water to be placed in a boiling heat to detach it. Nor could the whole, even by this means be collected in a separate state by the present apparatus, without suffering a part of it to be re-absorbed during the process. The bulk of it, which was afterwards readily imbibed by an aqueous fluid, and decomposed lime water, was undoubtedly fixed air, and the residue may be safely considered as *phlogisticated*, because *pure* atmospheric air is incompatible with the presence of iron. By seizing the phlogiston, it decomposes the metal, and becomes *phlogisticated*.

The spontaneous evaporation of the aërial volatile parts may assist us in explaining the increased specific gravity of the water, after standing some time in an open vessel.

14. From the experiment by evaporation, we ascertain the quantity of neutral salts, and other ingredients of a fixed nature contained in a gallon of the water.

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*Its purging Salts.*

15, 16. From these experiments we learn, that the purging salt of this water consists chiefly of a native Glauber salt, with an admixture of Epsom salt. Some have supposed these two salts to be perfectly similar. They agree, it is true, in their sensible qualities, and frequently correspond in the form of their crystals. They differ however in their basis, while the acid is the same. The Glauber salt having the mineral alkali for its basis, the Epsom salt, magnesia. Hence the former remains undisturbed by an addition of a fixed alkali or lime water, while the latter grows cloudy, and undergoes a decomposition.

tion. These salts therefore are essentially different, though they seem to be combined in the water, and testify an agreement in some of their more obvious appearances. The chrystals of the Epsom salt are sometimes so large, that they are sold in England for Glauber's salt; and on the other hand, in France, Glauber's salt being reduced to small *spiculæ* by agitation during the chrystalization, is vended for Epsom salt. But these frauds may be easily detected by the above test.

17. This experiment shews, that the Cheltenham salts are as perfectly neutral as the purest Glauber or Epsom salts of the shops.

18, 19, Afford incontestible evidence that the salt of this water, which has been pronounced to be nitrous by Dr. SHORT, and repeatedly echoed as such by succeeding writers, does not in truth bear the remotest analogy to that salt, nor yet to the *ναιρρον* of the

the

the ancients, or fossil alkali of the moderns, neither of which are of a purgative nature. Neither does it bear any resemblance to calcareous nitre as others have asserted; the former yielding permanent chrystals, the latter a deliquescent mass, incapable of perfect chrystalization.

The reason why the Cheltenham salt, in *experiment* 19, proved soluble in a less proportion of water than the common Glauber salt, seems partly owing to the portion of Epsom salt accompanying it. The water essential to the chrystals of this salt being very considerable, increased the menstruum, and promoted its solvent power. Thus water, after being fully saturated with Sal Ammoniac, becomes capable of dissolving a much larger quantity of corrosive sublimate than before.

20. This experiment shews that the earthy residuum contains a selenitic matter as well

as

as unneutralized magnesia, and that the latter is combined with fixed air, which being dislodged by the more powerful acids in this experiment, produces a conflict, and flies off during the effervescence.

21. This confirms the result of the experiment with galls, concerning the presence of iron, and shews it to be in a calciform state. By calcination with an inflammable substance, it acquires the necessary portion of phlogiston to render it sensible to the loadstone, though not so much as is required to reduce the calx into its metallic state.\* With respect to the quantity of iron contained in the water, it is undoubtedly small. Dr. LUCAS estimates it at four grains in a gallon: but it is by no means easy to ascertain this with

\* Iron, though hitherto considered as a simple metal, has lately been discovered to contain a portion of Plumbago and Manganese. How far the union of these substances may influence its composition, or vary its effects in medicine or the arts, may prove an object of interesting inquiry, particularly in England, where this metal abounds.



accuracy, or to collect the calx in a separate state by the usual method of filtration, without waste, and therefore it was not here depended on. If we may be allowed to judge from the purple tinge produced by an adequate proportion of martial vitriol, the iron may be presumed to amount to five grains.

22, 23. We have already shewn by *Exp.* 1, that the water when exposed to the air in an open vessel, in the ordinary temperature of the atmosphere, was deprived of its purple tinging quality in half an hour. This decomposition of the Chalybeate principle first takes place at the surface which is most exposed, hence the variegated film. The water, when tight corked, and sealed down, was found at the end of six weeks to have retained part of its fixed air, though not sufficient to suspend the Chalybeate principle. It is no wonder then that the bottle which had been kept the space of 22 years, had so totally lost it.

*How to preserve the Mineral Spirit—or to recover it when lost.*

24. It has long been a received maxim, that mineral waters, especially those of the Chalybeate kind, can only be drank in perfection at the fountain head, and that when their mineral spirit (as it is termed) is once lost, the Chalybeate principle vanishes; and that both are totally irrecoverable. The present experiment, however, affords a remarkable example of the contrary, and also points out an easy and simple method, by which both these fugitive principles may again be completely restored: A pleasing circumstance to those persons who cannot attend the spring, but are obliged to send for the waters at a great distance. It also supplies a convincing proof of the real nature of the mineral spirit, and its perfect identity with fixed air; that by the intervention of this subtile medium, the iron is converted into a saline substance, and

and is naturally dissolved in the water. That when this flies off, the iron does not accompany it as is vulgarly supposed, but only subsides, and is deposited at the bottom of the bottle, in form of ochre. It is observable that iron cannot be duly suspended in water by fixed air either naturally or artificially, without a superabundant quantity of air, beyond what is merely necessary to the solution of the iron. In order, therefore, to preserve a Chalybeate water in its full efficacy, it is necessary to re-impregnate it occasionally with iron, and also with an additional quantity of fixed air, till it is supersaturated with the latter.

Some attempt to preserve the mineral spirit of these waters, when intended for transportation, by pouring a little olive oil into the neck of the bottle before it is corked; but this is a very injudicious method. The fixed air being volatile, is capable of penetrating through

through a stratum of oil. The oil is moreover apt to contract a rancid quality, which it soon imparts to the water, and renders it very offensive. Others still more improperly direct the water to be kept in a warm room, which produces an intestine motion in the mineral contents, and extricates the phlogiston and aërial principles. Hence we may explain a chemical problem, which has not a little perplexed Philosophers, namely, the decomposition and precipitation which certain Chalybeate waters undergo, even in bottles hermetically sealed. The cause to me appears to be this. Though glass bottles thus secured be impermeable to aërial fluids, yet the principle of *heat*, which in *certain quantity* is essential to the composition of these waters, easily pervades the pores of glass. The escape of which instantly renders the menstruum incapable of suspending the mineral contents, and a decomposition inevitably ensues.

Water,

Water, I find, imbibes fixed air more powerfully in a cold, than in a warm season, and retains it more tenaciously in proportion as its temperature approaches the freezing point; and yet, what is remarkable, the moment it undergoes congelation, it loses it entirely. Hence the presence of fixed air appears to be incompatible with water, as soon as the latter approaches to a solid form: consequently, to preserve a permanent union between them, the extremes of heat and cold must be carefully avoided. The brisker kind of mineral waters therefore, whose Chalybeate principle is suspended by fixed air, ought to be kept in a cool cellar of equal temperature, the bottles being well secured, and inverted in a vessel of water. Nevertheless, when these principles are impaired or lost through a neglect of proper precautions, they may again be restored by the above artificial impregnation.

*Principles contained in Cheltenham Water.*

From the preceding experiments, a gallon of the water (*wine measure*) appears to contain the subsequent principles, and nearly in the following proportions, viz.

Native Glauber salt combined with a portion of Epsom salt,	— —	1 oz.
Sea-salt	— —	5 grains.
Iron combined with fixed air		5
Magnesia combined with fixed air		25
Calcareous earth or Selenite		40
Fixed air combined with a portion of phlogisticated air,	—	24 ounce
measures.*		

To these may perhaps be added a small portion of Hepatic gas.

\* Besides the fixed air retained by the earthy substances in the heat of boiling water, and what also was re-absorbed during the process.

By this term I mean *Hepar Sulphuris* converted into vapour by the separation of its phlogiston. It is so extremely subtile, that it instantly vanishes in the open air, and is only distinguishable by the peculiar fetid odour which is perceptible in the water, and also in the alvine discharges of those who drink it. Dr. LUCAS ascribes this odour to a putrid taint, in consequence of the water being shut up from the common air. But why then is there not a similar odour perceptible in the water of other wells, and pumps shut up equally close? Besides, does not the constant influx and reflux of the spring, not to mention the antiseptic quality of the fixed air, and neutral salts with which the water is impregnated, strongly militate against this supposed putrid tendency? Others, with less improbability, have attributed it to sulphur; but since the water neither undergoes any precipitation by concentrated nitrous acid, nor discolours silver when exposed to it, we  
 must

must not expect to obtain real sulphur though the constituents principles of its *hepar* be evidently present in a volatile evanescent state. Hence an impregnation of the hepatic gas easily eludes all the common tests, unless the water be fully saturated with it. May not this subtile vapour derive its origin from a decomposition of the sulphur (contained in the pyrites or iron ore, which supplies the Chalybeate principle) by the action of *pure* air on its phlogiston?

Now whether these constitute the whole contents of the water, or whether there may not be some other unknown principle, some link of the chain yet wanting, I shall not venture to decide. For the recomposition ought exactly to correspond with the decomposition, and a reunion of the different principles ought to be capable of reproducing the natural water, before the analysis can be pronounced to be absolutely complete.

But



But the researches of our best writers on Mineral Waters have rarely, if ever, attained this high pitch of satisfactory evidence, nor was there opportunity of putting the matter to this test in the present instance, because the entire contents were previously subjected to other experiments. The rapid progress of philosophical chemistry, however, encourages us to hope, that it may still be accomplished at no very distant period. And that a more accurate investigation of the mineral substances with which nature impregnates waters may enable us in time more fully to comprehend her hidden processes, and finally produce artificial impregnations that may emulate, or perhaps even surpass, the natural ones. Admitting the quality and quantity of the several ingredients to be once thoroughly known, it is humbly conceived that no very essential difference can arise from the hand that combines them.

*Their Medicinal Properties Separately considered.*

Here the reader will naturally expect some account of the medicinal virtues of the several component parts of this water in a separate state; but such an account, though ever so circumstantial, it is feared, would fail of conveying the desired information concerning the genuine effects of the water when drank fresh at the spring. Though some of its principles are far more active than others, yet as these are so exceedingly subtile, we must look for its medicinal virtues in the whole aggregate, rather perhaps than in any one of its constituent parts. It may not however be improper to observe in general, that the NEUTRAL SALT is the basis wherein its purgative and diuretic qualities principally reside. The virtues of this agree with those of the artificial Glauber salt, but its superior solubility renders it a more active purgative, and this quality is greatly heightened by  
 copious

copious dilution. Hence a quarter of an ounce of the salt contained in a quart of the water, operates more briskly than double the quantity when dissolved only in two ounces of water. Hence too we see the impropriety of the common purging draught, which directs an ounce of Glauber's salt to be dissolved in two ounces of water, a quantity too small to retain it in a state of solution, or to promote its due operation. The Cheltenham salt being prepared in considerable quantity from the water at the Spa in a portable form, its crystals may be preserved in bottles unimpaired by time, and may be usefully employed at a distance from the spring as a safe and gentle purgative. It may also afford an useful substitute for the water itself in inflammatory, or hectic disorders, where the Chalybeate principle might be deemed improper. By adjusting the dose, it may be determined to operate as a brisk purgative, or mild laxative and diuretic, and may therefore be added

occasionally to quicken the operation of the water, when it passes off too slowly; or may be dissolved in a small quantity, where large draughts of cold water are deemed improper, as in hydropic and leucophlegmatic habits.

The SEA-SALT, though very minute in quantity, may, when largely diluted, contribute its share to the purgative and diuretic effects of the other saline ingredients. And as this salt has the singular property of passing, unaltered in its nature, through the several stages of circulation; and after all, of being recoverable from the blood and urine of animal bodies, its de-obstruent effects in the remote parts of the frame may be more considerable than has been generally imagined. Does not the known efficacy of sea water in this respect, even when drank in small quantities as an alterative, tend to corroborate this opinion?

The IRON combined with the AERIAL ACID constitutes an active saline Chalybeate, which contributes to warm and invigorate the system, and to promote appetite and digestion.

The UNNEUTRALIZED MAGNESIA, as a laxative and absorbent, tends to correct ac-  
idities, and vitiated bile in the first passages, and to promote their expulsion.

Whether the CALCARIOUS OR SELENITIC MATTER impart any useful medicinal quality to this or any other water, seems at least very problematical. Inert substances of this nature pass with difficulty through the finer series of vessels, and can scarcely be subdued by the animal fluids. Waters which abound with them are extremely hard, and generally unfit for culinary purposes; and the inhabitants who are obliged to drink them, are often infested with the Bronchocele, and other

glandular tumours. The Cheltenham water however, by its purgative and diuretic qualities, expedites the passage of these terrene matters through the system sufficiently to obviate any effects of this nature.

FIXED AIR, though an important principle in this water, has hitherto been wholly overlooked by writers, or else confounded with the volatile vitriolic acid, from which, however, it is essentially different. The volatile vitriolic acid is easily distinguishable by its irritating corrosive quality, which destroys the colours of organized bodies; also by its stronger attractive power to other substances, and by being condensable into drops of genuine vitriolic acid. Fixed air on the contrary is a milder acid, is void of acrimony, and even destroys the causticity of other substances. In its separate state it is not condensable into drops, but remains a permanently elastic fluid. Its properties, indeed, have not  
 been

been minutely examined till of late, notwithstanding it is almost every where present; infomuch, that few waters are wholly divested of it, except those of ice and snow; which perhaps may explain why the latter prove so unwholsome when used internally, unless, by previous exposure in open vessels, they are suffered to re-imbibe a due quantity of it from the atmosphere.

Though it appears to be much less predominant in the Cheltenham Spa, than in some of the more brisk acidulous waters, yet we find, from experiment 13, that the quantity here is by no means inconsiderable. That portion which is loosely attached to it, and exhales spontaneously, imparts the chief medicinal power to the water. The residue adheres so closely to the mineral contents, as scarcely to be separable even by a boiling heat, and perhaps not compleatly by any means except congelation; and therefore, the  
full

full amount of it cannot be easily ascertained. It appears from observation, that fixed air communicates to simple water, an antiseptic, diuretic, and exhilarating quality. It is evidently this aërial principle which gives the agreeable smartness and poignancy to mineral waters, and which imparts life and energy to the other ingredients, by which they are enabled to pervade the remotest recesses of the human frame, and subdue some of the most obstinate diseases. To what other principle in their composition can we rationally attribute these surprising effects? Not surely to the water alone, which is totally incapable of producing them? much less to the mere solid contents which, either jointly or separately considered, are generally far too inactive and inconsiderable ever to exert such stupendous powers?

The PHLOGISTICATED AIR, and HEPATIC GAS, which also appear to enter the  
composition



composition of this water, may produce powerful effects proportionate to the peculiar nature of such subtile fluids. The latter may be expected to impart to the water virtues similar to those of Hepar Sulphuris, though it does not here assume so gross a form, or become so cognizable to the senses. But this is only offered as conjecture: The medicinal properties of these elastic fluids are far too little known to warrant us in drawing any certain conclusions concerning them. It is remarkable, that these, in common with fixed air, when received into the lungs in their elastic state, should prove extremely noxious, and suddenly destroy the irritability of the system. Yet when combined with water, they not only may be safely taken into the stomach, but prove highly medicinal.

AS CHELTENHAM WATER seems to derive its exhilarating quality from its aërial impregnation,

pregnation, curiosity prompted me to make the following trial of its effects on vegetation.

Exp. 25. Two plants of spear-mint were placed with their roots and stems in two separate bottles; one of the bottles containing Cheltenham water fresh drawn, the other common pump water. The plant in the Cheltenham water within two days drooped and withered, while the other remained in a healthy flourishing state. Hence though this impregnation be salutary to the human constitution, it appears to be very unfriendly to the principle of vegetation.

Exp. 26. Having drank the Cheltenham water regularly, during the space of three weeks, (except a day or two that its use was purposely suspended) and having attentively observed its effects on myself, and others who drank it under my direction, it was generally found to produce a slight giddiness, as well

as

as drowfiness, the first two or three days of drinking it, but seldom afterwards.

As a cathartic, it operated in a most easy, gentle, and certain manner, without materially accelerating the pulse, or depressing the spirits.

It moreover promoted appetite and digestion, and manifestly increased the secretions of urine and perspiration; the balance inclining sometimes to the former, at others to the latter, according to the state of the body, the degree of exercise, or exposure to heat or cold.

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*Diseases wherein this Water is indicated.*

From the foregoing account it appears, that this saline Chalybeate water is cathartic, diuretic, and sometimes diaphoretic, and that it operates by a very gentle stimulus, without

out evidently accelerating the circulation, or irritating the nervous system, like the rougher purgatives. It therefore seems to be principally indicated in the following diseases.

1. In morbid affections of the first passages, proceeding from costiveness, indigestion, acidity, vitiated bile, putrid fœces, hæmorrhoidal complaints, &c.

2. In diseases of the glandular and lymphatic system. From its cleansing and deterfive qualities, it promises great utility in affections of this nature, whether arising from an hereditary taint, intemperance, improper foods, or too sedentary a life. Under this class may be arranged, scrophulous and other tumours, obstructions in the abdominal viscera, particularly of the mesenteric glands, liver, spleen or kidneys.

3. In external diseases, and cutaneous affections. Under this head may be classed

various diseases, seated in more remote parts of the system, such as obstinate ophthalmias, fordid ulcers, together with scorbutic, and herpetic eruptions, and other cutaneous de-  
 fœdations.

4. In certain nervous complaints proceeding from impurities of the blood or lymph, or the suppression of customary evacuations. The above classes comprehend a great variety of chronic diseases, in which reason and experience seem to unite in bearing testimony to the propriety of this water. But its utility, I conceive, must depend on its being taken at a very early period, and *particularly so* in cases of the more *stubborn* kind.

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*Wherein doubtful—or directly contra-indicated.*

It is proper to observe, that many of the above-mentioned diseases are often compli-  
 cated

cated with others that require different treatment, and which consequently must render the use of this water sometimes doubtful, at others totally repugnant to the principal intention of cure. Thus a question arises of no small delicacy, how far it may be used with safety, and a prospect of success, in incipient consumptions proceeding from tubercles of the lungs? This may deserve the attentive observation of the discerning part of the faculty, who alone are competent to the task of distinguishing tubercles in their *nascent* state, or of obviating the progress of that fatal endemic malady, so highly destructive to the youthful inhabitants of this island. The ill success that has hitherto attended the several remedies extolled under the pompous terms of *vulneraries*, *pectorals*, and *balsamics*, tacitly admonishes us to adopt other methods of treatment, and to form our indications of cure on more rational principles. A mineral water therefore, which possesses the  
power

power of pervading the lymphatic system and of disburthening obstructed glands in remote parts of the machine, by promoting an increased secretion from the intestinal glands, and that without heating, or weakening the frame, seems to merit at least a candid trial. If the small portion of iron contained in the water, should be dreaded on account of its supposed *heating* quality, be it remembered, that this objection lies much stronger against the resinous *gums, balsams,* and *squills,* which are nevertheless daily exhibited in this disease, without fear or apprehension. But where tubercles, or other glandular tumours, have advanced to a certain pitch in the lungs or other vital organs, no permanent relief, it is to be feared, can be expected from this, or perhaps any other remedy hitherto discovered.

To particularize the various circumstances, wherein the use of this water may be doubtful

ful or improper, would be not only tedious, but superfluous. It may be sufficient to observe in general, that wherever the vital powers have been greatly diminished, or the strength impaired by natural, or artificial discharges, or other debilitating causes, or finally, where evacuants depress the spirits, or irritate the nerves, it ought by no means to be administered as a direct purgative, nor even in small doses as an alterative, without the utmost circumspection. Neither ought the purgative course in any case be continued for several weeks successively without intermission. Much less should this water be ever wantonly drank, or unnecessarily, as certain ignorant rustics are wont to do without measure or bounds, as if profuse purgation was a matter of indifference, or rather necessary to improve good health,—a fatal delusion, which undermines the powers of life, and in weakly habits, generally ushers in a long and dismal train of hypochondriacal or nervous

vous



vous symptoms! Nor are instances wanting wherein impaired vision, or even a *Gutta Serena*, have been occasioned by an abuse of this kind.

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*Directions for drinking it with success.*

The most suitable season for a course of the Cheltenham water, is undoubtedly during the summer months, namely, from the middle of May, till the latter end of September. In cases of exigency, it may be used at other times, though seldom with equal advantage.

With regard to preparatory means, internal medicines are generally superfluous; the water itself supplies its own proper preparative, and, if properly managed, supersedes the use of other evacuants. Warm bathing indeed is sometimes previously necessary to its success in certain stubborn cases, attended

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with

with obstructed perspiration, rigidity of the fibres, spasmodic strictures, cutaneous affections, &c. In these, and various other instances of this kind, the celebrated warm springs at Bath very justly bear the pre-eminence, and ought therefore to precede that of Cheltenham, or rather supply its place. The Bath waters are, moreover, much better provided with every necessary convenience for general or partial application. The Cheltenham water, in its turn, presents us with a very useful preparative for a course of the Bath waters, or even its neutral salt, where a gentle cooling purgative only is required.

Early rising being conducive to health in general, and to the successful use of this water in particular, the drinkers ought to repair to the spring at an early hour, and drink the water fresh at the fountain head, the instant it is poured into the glass, lest the ærial particles should exhale.

Admitting

Admitting the importance of these subtile fluids, we may account for the material difference found between drinking the water in this state, and after it has stood exposed to the air, or been conveyed to a distance. For though it retains its purgative quality after the volatile parts have escaped, yet it seems not now to pass so far into the habit, or to produce the same effects, as when it is drank fresh, and replete with these active principles. Hence we perceive the error of those who, through indolence or inattention, content themselves with having the water brought by their servants to their lodgings in bottles, often very imperfectly corked.—A custom too prevalent, especially among people of fashion, who thus lose the main efficacy of the water, not to mention the exercise in the open air so highly conducive to its success.

At the beginning, it may be prudent to drink only a quarter of a pint three times a

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day

day at proper intervals from meals. For instance, the first glass an hour before breakfast, the second an hour after breakfast, and the third about eleven o'clock, walking or riding between each glass. Thus the whole may be conveniently over before noon, and also admit of a pleasant airing before dinner. After the first week, the quantity may be increased to half a pint or upwards, three or four times a day, according to its operation, and the intention of the Prescriber. When it passes off too slowly, a glass may be taken in the evening, or a quarter of an ounce of the neutral salt may be added to a half pint glass of the water (in which it will readily dissolve) for the morning dose; drinking immediately after it a basin of warm tea or gruel, especially if the water occasions a sense of chillness, or flatulency in the stomach or bowels. Some, with a view to obviate these inconveniences, heat the water over the fire, which, by dissipating its volatile parts, diminishes  
its

its virtues, and instead of rendering it more palatable, as Dr. RUTTY persuades us, makes it much more nauseous. Others, with a similar intention, have recourse to tinctures, essences, or sundry aromatic seeds in form of comfits, or sugar plumbs; when a glass of simple peppermint water, or even brisk exercise alone, would answer the intention much better, and that without perverting the operation of the water, or injuring the digestive powers, which an habitual use of such remedies is extremely apt to do.

A course of this water may require from three to five weeks or upwards, but not without suspending its use two or three days at proper intervals, and then finally leaving it off in the same gradual manner in which it was begun, using for two or three weeks after, a more abstemious diet, and guarding against costiveness. The propriety of the above caution will appear obvious, when it is considered,

sidered,

sidered, that large evacuations when long continued, and afterwards suddenly suppressed, are oftentimes followed by a dangerous *plethora*, especially if a free course of living be imprudently indulged. Hence perhaps may be explained the vertigo, head-ache, lethargy, and other manifest symptoms of plenitude, which are wont to succeed such improper management, and which in general might very easily be prevented by due attention to these particulars.

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### *Diet and Regimen.*

Intemperance, or inattention to diet or regimen, may entirely defeat the hopes of the patient as well as of the Practitioner, in regard to the utility of this water. Such are the immoderate use of gross animal food, the abuse of strong liquors, indolence, late hours, hot rooms, and sudden exposure to cold,

cold, particularly in the night season, or drinking cold liquors after the body is heated by dancing, or other violent exercise.

The food, on the contrary, ought to be moderate in quantity, simple, easy of digestion, and nutritious. It should also be accompanied with a due proportion of farinaceous aliment, and esculent vegetables, many of which the soil of this country produces in great abundance, and very high perfection.

Milk and light spoon-meats are in general preferable to either tea or coffee. Chocolate may be also used with freedom.

Summer fruits either before or after meals are by no means objectionable, provided they are perfectly ripe, and eaten with moderation.

The exercise should consist chiefly of riding or walking, and should be used before meals, and regularly pursued during the whole course.

Above all things, the mind ought to be kept tranquil or agreeably amused.\* Deep concern about business, or domestic affairs must for a while be dismissed, and every cause of grief, anxiety, or inquietude, diligently avoided:—A circumstance of the utmost importance, and ever to be had in view by those who wish to reap lasting benefit from a course of the water.

Having thus attempted briefly to point out the general principles of the Cheltenham water, the diseases in which it is indicated, and the directions necessary to its successful use, I forbear descending to particulars. The nature of the water being once understood, these will readily suggest themselves to the intelligent Reader. As no invariable rule in matters of this sort can be laid down, the

\* Respecting the Public Amusements, Natural Curiosities, Agreeable Rides, Extensive Prospects, &c. appertaining to the place, See THE CHELTENHAM GUIDE,—THE TOUR TO CHELTENHAM,—and HISTORY OF GLOUCESTERSHIRE.



discreet Practitioner will vary the plan according to the operation of the water, the state of the disease, the constitution of the patient, and other circumstances.

To CONCLUDE:—Since the nature and qualities of mineral waters can only be ascertained by a series of experiments and observations instituted on the spot, it were earnestly to be wished, that a NEW, AND ACCURATE ANALYSIS OF ALL OUR PRINCIPAL SPRINGS were undertaken BY AUTHORITY, as a matter of PUBLIC CONCERN.

That in the interim, the resident Practitioners would expedite the work, by preserving accurate journals of the principal cases committed to their care, candidly noting down the UNSUCCESSFUL, as well as the successful events. The result of such an inquiry, impartially stated, would redound much to their honour, and afford the public

more satisfactory information concerning the waters, than they have ever yet been favoured with.

It would also rescue our medicinal springs from the opprobrium of being frequented, as they now commonly are, on no better foundation than that of fashion, or caprice. Some it would raise to public fame, that are now obscurely known; others it would strip of their false renown, by exposing the fabulous cures, attributed to them by ignorance, self-interest, or superstition. Each would thus, in time, find its own proper level in the scale of merit. Their natural and chemical history being finally completed, their comparative virtues would be ascertained, science enlightened, and the practice of medicine improved.

Distant Practitioners would then be enabled to form a more adequate judgment concerning them, and, instead of being misled  
by

by the erroneous opinions of preceding writers, would be qualified to correct them. Instead of sending their Patients indiscriminately from one Mineral Water to another, they would, in the first instance, be competent to determine their choice with propriety. Instead of dispatching them in pursuit of *imaginary* virtues, they would be enabled to direct them to those that were *real*.

Any communications on the above plan, relative to the Cheltenham Water, wherein the cases are *important*, and the facts *well authenticated*, will be very acceptable to the Author of this little Essay, and also gratefully acknowledged, should a future Edition be called for.

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